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And an ephemeris for the next few years:—

	°	″		°	″
1895·5	203·3	4·85	1898·5	212·3	4·75
1896·5	206·3	4·82	1899·5	215·4	4·70
1897·5	209·3	4·79	1900·5	218·4	4·64

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A Comparison between the Results of the Radcliffe Catalogue of Stars, 1890, *and the Greenwich Results*, 1887–91, *contained in the Greenwich Five-Year Catalogue*, 1890. By E. J. Stone, M.A., F.R.S., Radcliffe Observer.

The Radcliffe Catalogue of 6,424 stars for the epoch 1890, which has just been distributed, and the Cape Catalogue for 1880, will afford positions of all the stars in the southern hemisphere of not less than the 7th magnitude, except those in clusters, and of fainter stars in those portions of the sky where there are no stars so bright as the 7th magnitude.

The Radcliffe Catalogue has been purposely made to overlap to a considerable extent the work of the Cape Catalogue in order to afford materials for a comparison of the results. A complete comparison of the positions of all the stars contained in these catalogues is nearly completed; the results show that the agreement both in right ascension and north polar distance between the Radcliffe Catalogue and the Cape Catalogue, 1880, is a very close one.

The comparison has also been extended to the stars common to the Radcliffe Catalogue and the Greenwich Catalogue for 1880. These comparisons show that the north polar distance results of the Cape Catalogue fall between those of the two northern observatories, and that the differences are not large for either observatory. But the differences between the Radcliffe and Greenwich results are systematic, and are common to both the Greenwich Catalogue for 1880 and to the small catalogue of 258 fundamental stars, 1890 which has just been issued. I have given, therefore, in the present paper a table which shows the differences between the Radcliffe results and the Greenwich results for 1890 for the small catalogue of fundamental stars.

I need hardly say that all the corrections which I know to be necessary to clear the Radcliffe observations from systematic errors have been applied; but, of course, I do not expect that systematic errors have been entirely avoided. The differences between the direct and reflexion results found at Oxford have been too small, as may be seen on reference to the annual volumes for 1880–87, to render any corrections in this direction necessary; and the Radcliffe results are independent of *any*

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empirical corrections. It is desirable to point out, what is certainly the fact, that the systematic corrections which have been applied to the Greenwich north polar distances for the "R—D discordance" are of the same order of magnitude and of sign as the discordances which exist between the Greenwich and Radcliffe results; and that the validity of the application of a correction of the form—constant × sine Z.D.—to the north polar distance observations when the constant used sensibly differs, as is the case at Greenwich, from that which is directly obtained for the horizontal flexure of the telescope, is, at least, very doubtful.

The corrections applied for R − D at Greenwich for some years past do not differ very greatly, and this proves that some such corrections are required to reconcile the *direct* and *reflexion* observations; but it certainly does not prove that such residual results can be correctly represented under the assumed form, and that they are applicable to the direct results, when the assumption appears to be negatived by the flexure observations.

The following table, extracted from the Greenwich volumes 1887–1891, gives the corrections applied to the direct north polar distance observations for those years, and these may therefore be taken as indicating the kind of corrections which have been applied to the results of the Greenwich 1890 Catalogue.

Correction for Discordance of Reflexion and Direct Results, Greenwich Observations.

N.P.D.	Corrections to Results of Direct Observations. 1887.	 1891.
°	″	″
− 45	−0·69	−0·55
40	0·68	0·54
30	0·65	0·51
20	0·60	0·47
− 10	0·53	0·41
0	0·44	0·35
+ 10	0·34	0·27
20	0·23	0·18
30	−0·12	−0·09
40	0·00	0·00
50	+0·12	+0·09
60	0·24	0·18
70	0·34	0·27
80	0·44	0·34
90	0·52	0·41
100	0·59	0·46
110	0·63	0·50
120	0·66	0·52
+125	+0·67	+0·52
Horizontal Flexure.	−0″·06 sin Z.D.	+0″·06 sin Z.D.

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The astronomical flexure of the telescope would, therefore, appear to be practically insensible, and quite inadequate to give rise to corrections such as those contained in the above table. It will be seen that in measuring directly a distance between the pole and the equator we have differences amounting to 0″·9, according as we apply or neglect these corrections.

I do not, of course, wish to assert that the discordances which exist between the Radcliffe and Greenwich observations are entirely due to the application of these corrections, or that the corrections applied at Greenwich are without warrant; but the discordances between the catalogues would certainly be much smaller if these corrections had not been applied, and the validity of the application of such corrections to the direct Greenwich results is, in my opinion, at least very doubtful.

The solar observations at Greenwich indicate that the Greenwich right ascensions should be increased; and this correction is in the direction indicated by the comparison between the Radcliffe and Greenwich observations so far as the stars in the northern hemisphere are concerned, but not for those in the southern hemisphere.

The comparison between the Radcliffe Catalogue, 1890, and the Cape Catalogue, 1880, show similar but much smaller changes of the differences in right ascension near the equator; and the mean differences between the Radcliffe and Cape Catalogues given by the general discussion are rather smaller than those indicated in the limited comparison here instituted through the stars common to the three catalogues.

Comparison between the Corresponding Results of the Radcliffe Catalogue of Stars for 1890 *with the Greenwich Five-Year Catalogue of* 258 *Fundamental Stars for* 1890.

	Limits of Group N.P.D.	Mean N.P.D. of Group.	Radcliffe minus Greenwich in R.A. × sin N.P.D.	Weight.	Radcliffe minus Greenwich in N.P.D.	Weight.	R – D applied to Greenwich Results.
	° °	°	s		″		″
1	–5–0	– 2	+0·001	422	–0·16	272	–0·38
	0–5	+ 2			+0·28	268	
2	6–22	15	–0·032	14	+0·23	36	–0·25
3	23–38¼	30	+0·009	19	–0·68	38	–0·11
4	38¼–58	50	+0·024	80	–0·78	80	+0·11
5	59–68	64	+0·040	257	–0·73	189	+0·25
6	69–78	73	+0·043	421	–0·83	279	+0·34
7	79–88	83	+0·035	550	–0·98	274	+0·42
8	89–98	93	+0·020	328	–0·87	177	+0·49
9	99–108	103	–0·020	295	–0·86	173	+0·54
10	109–120	114	–0·046	115	–1·16	76	+0·57

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Procyon and *Sirius* have not been included in the comparison owing to their orbital motions, but the results would not have been sensibly affected if they had been included.

Comparison between the Results of the Radcliffe Catalogue, 1890, *and the Cape Catalogue,* 1880, *for the same Stars for Groups* 4, 5, 6, 7, 8, 9, *and* 10.

	Limits of Group N.P.D.	Mean N.P.D. of Group.	Radcliffe minus Cape Catalogue, 1880, in R.A.	Weight.	Radcliffe minus Cape Catalogue, 1880, in N.P.D.	Weight.
	° °	°	s		″	
4	38¼–58	50	+0·031	30	−0·35	20
5	59–68	64	+0·052	199	−0·45	49
6	69–78	73	+0·046	358	−0·46	68
7	79–88	83	+0·037	509	−0·46	104
8	89–98	93	+0·028	414	−0·70	84
9	99–108	103	−0·007	323	−0·45	77
10	109–120	114	−0·005	250	−0·27	53

The weights of these comparisons and the accuracy of the mean differences are somewhat diminished from the comparatively few observations of the north polar distance of the northern stars contained in the Cape Catalogue, and the few southern stars contained in the Greenwich Catalogue, 1890.

The general discussion of the solar observations made at the Radcliffe Observatory gives with the latitude adopted in the General Catalogue a correction for the north polar distances of only −0″·015.

The comparisons here given show that the systematic differences between the Cape results and those of the two northern observatories are rather less than half a second of arc, and these differences include the errors of the refraction tables, with the effects due to different exposure of the thermometers, and any uncorrected division errors. The systematic differences between the different catalogues are certainly larger than could be wished, but a second of arc is only one ten-thousandth part of an inch on the Radcliffe circle.

Such comparisons as those here made appear to me to throw some light on the supposed inaccuracy of meridian observations.

When a sufficient number of observations are grouped together to reduce the errors of the refraction tables to mean errors, the results of the comparisons between the north polar distances contained in the Cape Catalogue of 1880 and the Greenwich and Radcliffe Catalogues lead to the following results:—

The observations contained in the Cape Catalogue, 1880, gave directly zenith distances, and they were referred to the south polar point, with a zenith distance of the polar point determined from observation, subject also to errors of determination instrumental and reductional, including the errors of the refraction

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tables with the *adopted* thermometer exposures. The southern observations thus gave independent south polar distances.

The corresponding observations included in the Radcliffe Catalogue, 1890, have given independent north polar distances subject to similar errors of zenith distance and of polar point.

These results are only comparable on the assumption that the angle between the polar points is *exactly* 180°. We are, therefore, when the observations are thus independently referred to the north and south polar points, measuring 180° when comparing north polar distances made at the northern and southern stations; and when, therefore, the mean differences between the northern and southern observations are confined within such limits as ±0″·5 we are practically obtaining results within the $\frac{5}{180 \times 60 \times 60 \times 10}$ part, or the $\frac{1}{1296000}$ part of the quantity measured. It remains to be proved that other astronomical methods are more accurate than meridian observations for the measurement of such large angles.

It is undoubtedly true that small angles can be measured with much greater accuracy by other methods; but when differential methods are adopted we have to guard against an accumulation of the effects of the errors made in passing by summation from the small angles directly measured to the larger angles with which we are concerned in practice.

Radcliffe Observatory, Oxford:
1894 *November* 8.

Comparison of the Pulkowa Catalogue, 1885, *with the Greenwich Ten-Year,* 1880, *and Five-Year,* 1890, *Catalogues.* By W. G. Thackeray, Royal Observatory, Greenwich.

(*Communicated by the Astronomer Royal.*)

The observations of the Pulkowa Catalogue for 1885 extend over the years 1882–1891, and are a continuation of the series of declinations made with the vertical circle at Pulkowa, of which the Catalogues for 1845 and 1865 are well known. Before the observations for the present catalogue were begun the vertical circle was thoroughly overhauled, the pivots re-turned, and the circle re-divided. The Catalogues for 1865 and 1885 are in all respects similar, and the observations are reduced with the same refraction and the same value of co-latitude. The results for 1885 have been further corrected for variation of latitude in accordance with a paper of M. Nyrén's in *Bulletin de l'Acad. de St-Pétersbourg*, N.S. III.

From a comparison with the results of the 1865 Catalogue, M. Nyrén concludes that the adopted refractions would be better for